

GENERAL NOTES

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FENNEL (*FOENICULUM VULGARE*), PRIMARY HOST PLANT FOR THE EASTERN BLACK SWALLOWTAIL (*PAPILIO POLYXENES ASTERIUS*) (PAPILIONIDAE) ON THE EASTERN SHORE OF VIRGINIA

Additional key words: life history, parasitoids, secondary plant chemicals.

The eastern black swallowtail, *Papilio polyxenes asterius* Stoll, is a common butterfly that occupies a wide variety of habitats such as fields, gardens, wastelands, and marshes. Its geographic range extends from Quebec west to Colorado and south to the mountains of northern South America (Opler & Malikul 1992). It is one of several species of the *machaon*-complex whose larvae feed primarily on plants in the subfamily Apioideae (Apiaceae = Umbelliferae) (Berenbaum 1981a).

Hosts of the black swallowtail include many plants in the family Apiaceae and a few plants in Rutaceae and Asteraceae (= Compositae) (Munroe 1960, Wiklund 1975, Berenbaum 1978, Scott 1986, Scriber & Finke 1978). Queen Anne's lace or wild carrot, *Daucus carota* (L.), is a common umbellifer on the Eastern Shore of Virginia. It grows along roadsides, in fallow fields, and in waste places throughout the eastern United States. Queen Anne's lace often has been reported as the primary host plant of the eastern black swallowtail (Scriber & Finke 1978, Blau & Feeny 1983).

Fennel, *Foeniculum vulgare* Miller, is a perennial plant in the Apiaceae. It has decom-pound leaves and filiform segments, with compound umbels of small yellow flowers; it blooms from June to September depending upon weather conditions. Fennel is known to be a host plant for the Old World swallowtail, *Papilio machaon* L., and the anise swallowtail, *Papilio zelicaon* Lucas (Berenbaum 1981b, Wiklund 1975, Scott 1986). It also has been noted by Stokes et al. (1991) and Ajilvsgi (1990) to be an occasional larval food plant for the eastern black swallowtail. On the Eastern Shore of Virginia, black swallowtails appear to use fennel as their primary host plant. Although both Queen Anne's lace and fennel commonly grow together, eggs, larvae, and ovipositing adults have been found only in association with fennel.

On the Eastern Shore of Virginia (Northampton County) fennel and Queen Anne's lace grow along most roads, pastures, and plowed fields. Both are very hardy and appear to persist under heavy disturbance. Fennel grows in thick clusters; mature plants reach heights of over 2 m. Queen Anne's lace grows in more diffuse patches that are usually spread out over a large area; mature plants reach heights of up to 1.5 m.

In October 1992, we first observed black swallowtail larvae feeding on fennel on the Eastern Shore of Virginia National Wildlife Refuge (ESVNWR). Twelve larvae were collected and returned to Virginia Commonwealth University (VCU) in Richmond, where they were fed fennel and exposed to an 8:16 (L:D) photoperiod. Pupae were placed in a constant temperature chamber at 4°C for winter. On 1 May 1993, the pupae were placed under a 16:8 photoperiod at a day/night temperature of approximately 24/18°C. After 15 days the first adult swallowtail emerged. Of the 12 larvae collected, two pupated but did not emerge, four emerged as healthy adults, and 6 pupal cases each contained a single parasitic wasp, *Trogus pennator* (Fabr.) (Hymenoptera: Ichneumonidae), a common parasite of swallowtail larvae/pupae (Heinrich 1962). One adult swallowtail and the wasps were saved and pinned as voucher specimens at VCU.

From September through November 1993, we collected over 30 black swallowtail larvae from fennel growing in the ESVNWR. No larvae were detected on Queen Anne's lace. Eighteen of the resultant pupae were allowed to diapause as described above. On 1 May 1994, pupae were placed at a day/night temperature of 24/18°C and exposed to a 16:8 L:D photoperiod. Adult eclosion began on 19 May. In all, six butterflies and eight *T. pennator* emerged; four pupa were dead. A summary of butterfly emergence and parasitism for 1992 and 1993 is shown in Table 1.

In September 1994, we searched fennel and Queen Anne's lace growing in the

TABLE 1. Fate of 30 *Papilio polyxenes asterius* Stoll larvae collected on the Eastern Shore of Virginia National Wildlife Refuge, 1992–93. All larvae pupated successfully; pupal parasitization was by *Trogus pennator* (Fabr.).

Year	Pupated	Died (%)	Eclosed (%)	Parasitized (%)
1992	12	2 (17)	4 (35)	6 (50)
1993	18	4 (22)	6 (33)	8 (44)
Totals	30	6 (20)	10 (33)	14 (47)

ESVNWR for black swallowtail eggs and larvae. Four females were observed ovipositing on fennel, and a total of 97 eggs and 42 larvae of various instars were collected from fennel. No black swallowtail eggs or larvae were observed on Queen Anne's lace despite the fact that this plant was abundant.

Our observations suggest that black swallowtails on the Eastern Shore of Virginia use fennel as their primary, and perhaps exclusive, hostplant. This utilization parallels the shift in host plant preference by the anise swallowtail, *Papilio zelicaon*, in coastal California. Increased abundance of *Papilio zelicaon* has occurred on the West Coast, and our preliminary data suggest that black swallowtail numbers are higher on the Eastern Shore of Virginia than in our study site in Chesterfield County, Virginia.

Host plant transfer to fennel could be deleterious to *P. polyxenes* larvae. Fennel contains furanocoumarins (Murray et al. 1982) which are toxic to most phytophagous insects. However, xanthotoxin enhances *P. polyxenes* larval growth (Berenbaum 1981b). In our laboratory, larvae pupated and adults emerged and subsequently deposited viable eggs when reared on fennel. Both fennel and wild carrot occur in great abundance on the ESVNWR. We have counted over a thousand plants of each species within a 20 m² plot. The excessive numbers of each in various stages of development during the entire April–November growing season precludes oviposition selection due to population density alone. It is known that wild carrot is less attractive for oviposition in the fall (Feeny et al. 1985); however, we have observed both oviposition and larval feeding only on fennel throughout the April–November season at the ESVNWR.

The shift of *P. zelicaon* to fennel in coastal California may be due to the presence of palatable foliage throughout the summer. Most of the native umbellifers are in leaf and/or flower only in the spring or fall due to the Mediterranean climate which includes dry, hot summers. We suggest that the shifts in host plants reported for *P. zelicaon* and *P. polyxenes* could have a chemical basis (e.g., fennel may contain larger quantities of an oviposition stimulant such as luteolin-7-*O*-(6'-*O*-malonyl)-*B*-*D*-glucoside (Feeny et al. 1988)).

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FIFTH INSTAR PARASITOIDS OF ANAEA RYPHEA (NYMPHALIDAE): THE MISSING DATA

Additional key words: population ecology, pupal mortality, Tachinidae.

In two previous articles, I described the life cycle of *Anaea ryphea* Cramer (Caldas 1994) and the population ecology of its immatures (Caldas 1995). These studies were conducted at Campinas, Brazil (22°54'S, 47°05'W, 650 m elevation) and included results on larval and egg parasitoids. However, I failed to identify mortality factors acting on fifth instar larvae and pupae, because preventing fifth instar larvae from leaving the foodplant for pupation might have influenced the number of future adults within that population, and therefore the study that was being carried out (see Caldas 1995 for details). To remedy this situation, after finishing the population studies, I decided to look for pupal and fifth instar parasitoids.

I collected 15 fifth-instar larvae of *A. ryphea* on plants of *Croton floribundus* Spreng (Euphorbiaceae) in late May 1994 at Itatiaia National Park in Rio de Janeiro state, Brazil (22°27'S, 44°37'W, 800 m elevation), a reserve about 300 km east of Campinas. I kept larvae in large plastic vials, and fed them until pupation. Eight individuals, immediately after pupation (less than 24 hours), started turning dark, eventually turning into a deep brown, whereas the other seven kept their typical bright green color. After 10–12 days, maggots emerged from four of the dark pupae (one maggot from each pupa), and immediately tried to pupate on the vial bottom. Only two pupated successfully. Adults were identified as a female of *Winthemia* Robineau-Desvoidy (Diptera: Tachinidae) and a female of *Jurinella* Brauer & Bergenstamm (Diptera: Tachinidae). Unfortunately, no males